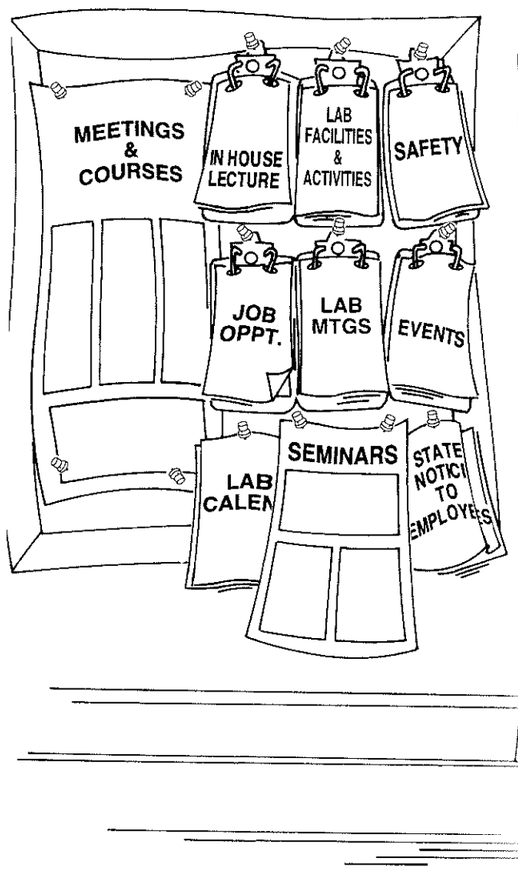


1

General Lab Organization and Procedures

WELCOME TO ONE of the most exciting and enjoyable workplaces ever evolved, the biomedical research laboratory. There is an amazing concept in operation here: You get paid or get credit for doing experiments, surely an almost scandalously delightful way to make a living. The work is worthwhile. The dress code, if any, is casual. The work hours are often self-determined and based on the needs of the experiment. The lab or department is filled with bright and interesting people with whom you can discuss the salt concentration needed for a kinase assay or the implications of the latest congressional bill. It can come to have all the psychological comforts of home.

Like any complex social organizations, research laboratories have their own customs and rules. The difficulty is that the rules have been unspoken. You are expected to decipher the many obtuse clues and become a law-abiding member of a society in which individualism is highly prized. Although no one is expected to show you how to work the equipment, you will be expected to work it. In a profession in which communication of data is the goal and the reward of the research, not all people can communicate with you clearly and satisfactorily. Don't worry, you will manage! In a short time, the pleasure of working together with colleagues on interesting and similar projects will supplant any initial feelings of unease. But to get your work done well, you must first navigate among sometimes vague and mixed signals and learn how your laboratory beats and hums.

THE BIG PICTURE

A lab is defined by a number of overlapping terms, depending on the audience for whom the lab is being described. A lab may be described in terms of its basic *field*, such as immunology, physiology, or biophysics: This is more of an administrative definition than a functional one. The *experimental model*, the organism used to address the question, is often used to expand the description of the field of research. For example, someone may be a member of a microbial ecology or yeast genetics or a human neuroanatomy laboratory.

The *area of research* is a more practical way to describe a laboratory, since it tells you what the lab actually does: One might say that the lab is a cell cycle lab, or a signal transduction lab. The lab probably has a *focus*, a question that binds all the lab members. The entire lab may be working on the proteins involved in secretion from neurons, or trying to understand why and how a particular transcription protein is involved in development. And individual lab members have their own *questions*, a specific problem that they are trying to solve experimentally.

Another way the laboratory has been defined is by whether it is engaged in *basic* or *applied science*. Basic science was assumed to be pure science, science done only for the sake of knowledge, whereas applied science has been thought of as the use of a basic science idea for the development of a product such as an antibiotic. *Basic science* was considered to be the child of academic research, funded by soft money (research support and/or salary funded by competitive grants). *Applied science* was thought to be performed in companies, funded by hard money (salary and research support are part of the job and are given by the institution or company). These distinctions are not valid. Basic and applied sciences are done in universities and pharmaceutical companies, and research at academic institutions and companies is funded by both hard and soft money. To those who work in labs, the practical similarities are more apparent than the differences.

Some laboratories do *clinical research*, in which human patients or a patient's cells are used to investigate a disease or syndrome, and much of the work is done by medical doctors rather than Ph.Ds. Clinical research labs are usually found only at medical schools or institutions affiliated with a hospital, where there is access to patients.

Each laboratory is usually part of a larger unit, such as a *department* or a *division*, and shares facilities with all department members. Large pieces of equipment such as ultracentrifuges and –70°C freezers are often departmental, even if they are housed within an individual's laboratory. Cold rooms, warm rooms, dark rooms, film developers, autoclaves, and glassware washers may also be shared, unless they belong to a very large and extremely well-funded laboratory. Most departments have a library where some of the relevant journals of the field are located: Since most journals are on-line, the library more usually serves as a lunchroom or a small seminar room. If not the library, there will be a conference room, used for research presentations and journal clubs. And almost every department has a large bulletin board, near the [illegible]

retary, library, or main office, upon which are posted seminar times and places, job listings, meeting notices, and departmental happenings.

Use the department—do not hide away in the lab. The department is a resource that can provide ideas, equipment, and connections, and your dealings with the members of the department can greatly influence the happiness and productivity of lab life.

LABORATORY PERSONNEL

Laboratory groups have a dynamic that is fairly unique, in that people work more independently than in other groups, and the organizational structure tends to be rather horizontal. Practically, this means that *everyone is equal*, and it is usually no one's job to show you how to do things. Do not assume that because a person has a "lower" status than you, you can indiscriminately order that person to make a buffer for you: You might get the buffer, but you might also generate a lot of passive aggression. Antagonizing someone may mean that no one will clear out freezer space for you, take your tubes out of the water bath when you have forgotten them, or help you do a calculation until you change your attitude.

Treat all members of the lab with the same respect you give the P.I.

Laboratories have a variety of personnel working in them, with varying levels of commitment and various reasons to be there. The cast of characters commonly includes:

The principal investigator, or P.I. This person may also be known as the head of the lab, the boss, the advisor. The P.I. probably spends more time with administrative tasks such as writing grants or research reports than in doing lab work but is the intellectual guide behind most of the projects in the lab. Directly or indirectly, P.I.s are responsible for funding the laboratory research. The entire atmosphere of the lab—friendliness and camaraderie or vicious competitiveness—will depend on the P.I.'s personality and leadership.

Postdocs. This is short for "postdoctoral" associate, assistant, or fellow (the terms are institution-dependent). Postdocs have received their Ph.D. or, more rarely, M.D., and are doing a 2–5-year training period before looking for a position as a P.I. in a university or in industry. Postdocs usually work quite independently on their own projects, although they will collaborate with other lab members on particular aspects of the project.

Technician or research assistants. A technician can be a college student who wants to gain more experience in the lab before entering graduate or medical school, or a professional with an M.S. and the appropriate pay and title. In academic estab-

lishments, the norm is the new college graduate who will stay only for 2 years. In industry or in some medical centers, longer-term arrangements (with more money and prestige) are found. Technicians do a variety of tasks, including ordering supplies, preparing media, and caring for the lab's cell lines, assisting a particular lab member with their experiments up to designing and carrying out their own experiments.

A professional ... often the most knowledgeable ... lab.

Graduate students. Graduate students are doing lab work required for their ... or for a Ph.D. Generally, they work long hours and have a lot of time and ... invested in their projects. Like postdocs, graduate students have their own ... projects and become increasingly independent during their tenure of ... laboratory.

Rotation students. Many graduate schools require their students to work ... eral labs before they decide on the lab for their thesis work. These brief ... research are known as a rotation. Rotation students are in the lab for 6 ... months, usually on a short-term project. They may be required to do ... they may want to pick up techniques in a new field, or they may be testing ... before making a bigger commitment. But the rotation goes two ways: At ... the P.I. is also deciding whether or not to accept that student into ... uate student.

Undergraduate students. Undergraduates are the motor of the lab ... leges and universities, even at universities with strong graduate programs. ... to the lab for many reasons: for senior research theses, for independent ... work-study job, to get research experience and faculty recommendations ... tion to graduate and medical school, or just to get a taste of research. ... have already worked in a lab may be given their own small project, ... dents might make buffers for the entire lab or, most typically, be ... particular person.

Summer students. Summer students are usually college students, ... high school students. Many universities sponsor high school and college ... summer programs, paying a small stipend and overseeing the general ... dents. Undergraduate students approach the P.I. independently for ... for the same reasons as during the school term.

Residents. Residents are usually found in a medical center lab, ... aspect of human disease. They may spend several weeks to several ... associated with their field, usually doing a short-term project. A ... known as a fellow in some institutions.

Visiting faculty. During a sabbatical, a faculty member might go to another lab to learn a new technique, try a new field, or collaborate on a series of experiments.

Secretary or administrative assistants. The secretary may be in charge of ordering supplies for the lab, may help lab members with grant applications, and may organize lab seminars and journal clubs, or may work only to serve the P.I. directly. Be especially considerate of the secretary, who is one of the most important and necessary, but undervalued and rudely treated, people in the laboratory.

Laboratory aides. Some jobs in a department or laboratory are done by a laboratory aide, who is hired to perform a set of specific tasks. This person is usually not trained to be a scientist, but helps the lab greatly by doing tedious and time-consuming jobs. Examples of laboratory aides are *medium preparers* and *glassware cleaners*. The medium preparer makes and distributes cell culture media and bacterial broth and plates. A glassware cleaner—the one who washes the dirty glassware and pipettes and, perhaps, delivers the cleaned and autoclaved things—is a luxury that small labs may not be able to support. This job is likely to be a departmental one, with several labs being serviced by the same person.

Knowing someone's position in the lab can help you understand certain things that appear inexplicable. It can suggest which person might be the best person to consult on a particular scientific or personal problem. But do not define anyone by title alone, or you may pass by a potential fountain of information. You may also be impressed when you should not be!

Laboratory supervisors. The day-to-day operation of the lab may be overseen by a laboratory supervisor. The responsibilities of the laboratory supervisor might range from keeping the lab stocked and organizing journal clubs to suggesting experimental approaches. Whatever the situation, do not let the presence of a supervisor prevent you from ever interacting with the P.I.

Laboratory safety officers. A laboratory member, usually one who has been in the lab for a few years, is usually assigned to act as a liaison between the lab and the Environmental Health and Safety (EHS) department. If you have questions about health, safety, or the appropriateness of lab protocols, speak to the lab safety officer before you speak to someone in the EHS department. This is usually a departmental position.

LAB ROUTINES

Although labs have people coming and going through all hours of the day, certain routines and customs stand firmly in the apparent chaos. It will take a number of weeks before the rhythms of the lab are clear and you can make your place in this

environment. As much as you can without compromising yourself, initially try to work in with the routines of your particular lab.

Hours

Because experiments do not always fit into a 9-to-5 slot, lab workers often have long, unpredictable, and quite eccentric hours. Most people are allowed to regulate their own hours, with the most trust usually associated with academic departments. But even if the lab is an academic lab, and not a word is said or spoken about hours, *there is probably a standard of time commitment that is expected.* Companies and hospital departments tend to have more traditional hours, whereas academic departments may seem more casual, with more late night action. But in both, working less than the deemed and sometimes unspoken expected hours of work can stigmatize the new worker. Find out what hours of work are expected, and try to conform to this. If most people tend to come in late in the morning, and work evenings, try to do the same. Working hours dissimilar to other workers makes it difficult to get to know people and to obtain the help you need.

Position influences hours. Basically, because the lab is dependent on them, technicians and secretaries are expected to work more regular and predictable hours. But if you are expected to stay to finish experiments or projects, it is only fair that you should have more freedom in choosing hours.

Your personal situation may not allow you to work the lab's hours. Children, classes, commutes, and partners are some of the factors that will also influence the hours you can work. *Try to overlap with other lab members as much as you can.* Be up front about your hours, because you certainly do not want to be in a situation where you sneak around and get into weird behaviors such as leaving on lights or pieces of equipment to show that you were there. Hopefully, your work will speak for itself.

Vacation policy also varies from lab to lab and is usually unspoken. In many places, people are discouraged from taking vacations because it always seems as if it is the wrong time to leave a project: Either the project is going well, and you don't want to walk out on a run of good results, or it is not going well, and you feel too guilty to leave before you get it back on track. Take the time you deserve, but don't abuse the privilege of independent decisions.

Dress Code

One of the satisfying benefits of working in the lab is the freedom to wear whatever you like. People in hospitals and companies often dress more formally than do those in academic institutions, since they must interact with non-lab people and patients. People in academic institutions are more likely to be offended at the thought of having their clothing regulated, even by custom. This is a personal issue, but it is most likely that you can wear whatever you want, and no one will ever question you. There are few rules on dressing for the lab:

- Don't wear good clothes unless you want to spill phenol or bleach on them. Spills only happen to favorite or expensive clothes.
- Don't wear open-toe shoes or shorts. This is a rule in most laboratories, and is obeyed in few. If you are determined to wear shorts or sandals, take great care in doing experiments: Spilling phenol on pants is bothersome, but spilling it on your legs is a real health hazard.
- If you must wear a tie, keep it out of the Bunsen burner.

Laboratory Tasks, Lab Jobs, Assigned Jobs

In many labs, lab personnel *must share common jobs.* Typical jobs include making liters of a commonly used buffer, picking up the dry ice, changing the CO_2 cylinders on the incubators, or packing up the radioactive waste. These jobs may be permanent or may be rotated at regular intervals. Sometimes the job is a particular piece of equipment which the assigned person is responsible for keeping in good running order.

Take your assignment seriously. Do not let your assignments always come second to your own experiments. Other lab members may be dependent on the buffer you keep forgetting to make, and even if you do not absolutely ruin someone's experiment, you will get a reputation as a bad lab citizen. Try to do your jobs with cheer.

> ***Playing the radio.*** *Most labs have a radio or CD player in the main room, and the debate about the choice of music can quickly escalate into a war. Don't get into it. If you do not like the music, buy earplugs or a personal music player with headphones.*

Laboratory Meetings

Meetings are held in laboratories to discuss the current research of the lab workers, the current research of the field (since recent journal articles are often discussed, these are known as journal clubs), and organizational problems. These may be combined into one or two meetings: Small labs may not have their own meetings but be participants in departmental meetings. Many labs or departments have a *weekly journal club* and a *weekly research meeting.*

In *research meetings,* one or two people present their data. In some places, all lab members briefly talk. These talks may be casual, over lunch and with only a blackboard

> ***Attend all meetings.*** *Unless you have a desperately pressing experiment, arrange your time so that you can go to all journal clubs and research presentations. Content aside (and you will probably learn a lot), your attendance shows support for your coworkers and is important for departmental cohesiveness.*

or overhead projector, or they may be formal enough to require proper clothes and dress. *Journal clubs* are almost always quite casual, although local custom will dictate whether photocopies or the blackboard is used to present the paper. Often, the papers to be presented are listed a few days before the meeting so that everyone can read the papers and have at least a primitive working knowledge of the topic.

Who participates in lab meetings? The backbone of most lab meetings is the students and postdocs, with participation by technicians, faculty, and short-term personnel being dependent on lab policy. Certainly, if you are not required to join as long as you want to participate, you should ask the head of the lab if it is okay.

If you are expected to participate, you will usually be given a grace period, especially for research seminars. It is common, if you have previously done research, to give your first research seminar on your past research project. The format of lab meetings varies widely: Chapter 6 contains more details about participation in and preparation of lab meetings.

You are probably expected to participate, but you will usually be given a grace period, especially for research seminars. The format of journal clubs and research meetings varies widely. For your first presentation, at least, follow the lab format. Chapter 6 contains more details about your own presentations.

WHAT TO EXPECT THE FIRST WEEK

You will be assigned a lab bench, or a part of a lab bench. You may also be assigned a *desk*, either in the lab or in a common office area. Don't be offended if the place you have been given is very small—space is at a premium in most labs and, generally, the more successful the P.I., the more crowded the lab, and the less space each person is given. You may well see that means people have more space, but don't complain yet.

The P.I., or the person responsible for you, will probably sit down with you to discuss the project you will work on. The basics of the project were most likely outlined before you came to the lab, but this is the time you will find out the specifics. *If you are offered the chance to work closely with someone (rather than to work completely independently), grab it!* You will get much more help than if you are patching together instructions on your own, and you can negotiate your autonomy later.

If you can, read literature related to your project or the theme of the work in the lab, before the talk. Don't worry if everything does not make perfect sense, or even if it makes no sense at all—as soon as you do a few experiments it will all become clearer—it will give you the vocabulary with which to have the conversation.

You will get keys or a keycard for the lab, and an institutional I.D. The keys may not be only for your lab, but also for shared areas for other labs in the department. Don't abuse these keys by wandering around in other labs off-hours.

You will be assigned storage space in the refrigerator, –20°C freezer, and –70°C freezers. This is in theory: In practice, it may take longer for people to reorganize (for everyone will expand into whatever space is available) to make room for you. Find out where you can keep a few things while waiting for permanent space.

You will receive orientation through the Human Resources department. Through videos, readings, or lectures, there will be training on sexual and verbal harassment, as well as on drug and alcohol awareness. Take this training very seriously! There are institutional and legal repercussions for inappropriate behavior, so you want to be sure you know your rights and your limits.

You will have an appointment with EHS (Environmental Health and Safety, also known as Laboratory Safety and/or Radiation Safety), which functions as the overseer of personal safety, radiation use, and biohazard disposal. A film may be shown, or a lecture given, about general laboratory safety precautions and the particular rules of your institution. If necessary, you may be instructed on radioactivity usage and provided with a radiation badge used to monitor exposure to radiation. Especially if working with human blood or cells, you will need a hepatitis B vaccine series. Other vaccines or tests may be needed for working with particular organisms. A background thyroid scan should be done if anyone in the laboratory or department will be working with radioactive iodine.

Those working with human participants and materials (such as tissue, cell lines, DNAs, or proteins) derived from humans will be subject to specific rules. Each institution has an Institutional Review Board (IRB), whose purpose is to protect human subjects, and you will need to follow their ethical and practical guidelines. If you are seeking and using NIH funds for research involving human subjects, you will receive additional training: Currently, this training is available through an on-line course entitled "Human Participant Protection Education for Research Teams" (http://cme.nci.nih.gov). Speak with your supervisor to find out whether you need to contact the IRB.

If you will be working with vertebrate animals, you will receive animal training. This will usually be done through the Animal Facilities Department. You will probably have to contact the Animal Facilities Department yourself to set up training, and to be cleared for access to the animal quarters.

WHAT TO DO THE FIRST WEEK

Do an experiment! Do not wait until you understand the system to start experiments—you won't be ready to learn effectively until you have done your first experiments. It is magic, but it is the #1 lab truism. It will also help you feel and be considered as a productive member of the lab. The experiment does not have to be an earth-shattering one—In fact, *it should be simple* and be used to check your results against others in an assay often done in the lab.

Set up your lab bench. Order, find, clean, and arrange what you need for your desk and personal lab space. Think in terms of doing an experiment as soon as possible.

Introduce yourself to everyone. Lab workers come and go, people are busy, so don't feel slighted if you don't get the red carpet treatment. *Let everyone know* who you are, and what you are working on. A good icebreaker is to ask members about their own projects. Go to lunch with lab members at least once during the week.

Take notes on everything. This is not just a courtesy, but a *necessity*; you will be given so much information this first week that it is impossible to remember all the details. And details can be excruciatingly important when you find yourself alone at night and don't remember where the needed reagent is.

Familiarize yourself with how the lab is run, where things are kept, who does what and when. Watch and ask questions when it isn't too intrusive; don't ask about lunchrooms and telephones when someone is in the middle of an experiment.

Ask. True, you don't want to bother anyone, especially needlessly. But it is always better to ask a question about a procedure, a reagent, a piece of equipment, than to waste time and money. If you make a mistake, always ask a coworker if the mistake can be rectified. The same mistakes are repeated again and again by new workers, and there is a way out of many apparently botched experiments.

WHAT NOT TO DO THE FIRST WEEK

Don't constantly mention, when being shown something, that "we didn't do it this way in class/my other lab/the hospital." This is an implied insult that won't be appreciated. When you have been in the lab for a while, and have had a chance to really evaluate the lab's way of doing a particular thing, you will be able to introduce an improvement or to make your own decision about a method. But for now, listen.

Don't read a newspaper or a novel, or play computer games, in the lab. During every day in the lab, especially early on, there is a lot of dead (non-

Things to find out about the first week:

Chemicals. Where are the chemicals, how are they arranged, where are they weighed and pH-ed?

Computer usage. Do you have access to a computer? If so, when, and is a password or access number needed? Can you do literature searches on it? Is there a way to get onto the WWW? Can you e-mail? How do you get an e-mail address? What printers are available to you?

First aid. What is the number to call for an emergency? Where are the chemical spill and first aid kits? Where is the safety shower and how does it work?

Glassware. Where is clean glassware kept? Where does dirty glassware go? Does someone wash all the glassware, or must lab members take care of their own?

Institution library. Where is the library, and what do you need to use it? How do you make photocopies in the library? Can you access the library from the lab computer?

Lab coats. Does the institution provide lab coats? If they are cloth, does the institution launder them?

Lab meetings and journal clubs. What is the schedule for lab meetings and journal clubs? Is it posted? What is the format for the meetings?

Lab notebook. Is there a lab rule to follow when writing up experiment results? Are either loose sheets or bound sheets okay? Are the books or sheets provided? Is it necessary to make a copy of each day's data?

Ordering supplies. Does each individual make the phone call, or is someone responsible for ordering for everyone? Is there a strict budget to follow? Can ordering be done by computer? Who picks up the supplies when they arrive?

Photocopy machine. Is a card or number needed, or do you have to keep track of the number of copies?

Telephone calls. What is the phone number in the lab? Is there an answering machine or voice mail, and if so, how do you get messages? Must each person pay for personal calls?

Trash disposal. Who takes away the trash? Where does biohazard material go, and who is responsible for pick-up? Where do you dispose of needles and other sharps? How about recyclable paper?

Work hours. What hours do people tend to work? At what hours are your collaborators in? What is the best time to get first shot at the equipment?

experiment) time, but reading the sports section while others are working [illegible] will create a bad first impression. No, it shouldn't matter, but it does. [illegible] time to read relevant literature.

Don't ask or complain about money or salaries. This is a leftover from the science-in-the-sky days, when a serious scientist was supposed to be [illegible] ious to all else but work, and interest in money suggested that person was not content with the beauty of scientific discovery. Scientists have had to become more practical now, but there remains the feeling that money talk is tacky and unprofessional. Negotiate your salary and benefits before you arrive, and keep an ear open for hints of unfairness, but don't cloud the beginning of your job with recitations of what your friends in other labs are receiving as salaries.

In the first [illegible] members tend [illegible] dozens and [illegible] relevant to [illegible] research. [illegible] ever read, [illegible] remembered [illegible] an article does not [illegible] with the [illegible] information [illegible] are more likely [illegible] learn from paper [illegible] them immediat[illegible] ting down [illegible]

Don't use the telephone or photocopy machine excessively for personal reasons. Try to conduct as much nonprofessional business away from the lab as possible, or, at least, on your own cell phone. If you must use the lab telephone for personal reasons, keep the call as short (and quiet) as possible, especially if you share a phone with other lab members.

Don't suggest that you are working in the lab for any other reason than love of research. If you have another reason, keep it to yourself [illegible] will be perceived as not being serious about your work. By saying things such as "I'm only here to get a better fellowship," you demean most people's reason for being there.

SURVIVAL THROUGH COMMON SENSE AND COURTESY

Following simple lab courtesy is vital to maintaining a good relationship with your coworkers and getting your work done. This section might also be called "Lab Survival" or "**If you are going to read anything in this book, read this section**

Everyone in a lab is generally willing to help but is extremely busy, and [illegible] ing that will help you to learn how to ferret out the knowledge you need. [illegible] sound harsh, but they are common sense in an environment in which [illegible] functionally secondary to individual achievement and responsibility.

Even in folklore and fiction, the inconsiderate lab researcher has caused a problem:

> Vergil's dismissal would not have unduly distressed his fellow employees. In his three years at Genetron, he had committed innumerable breaches of lab etiquette. He seldom washed lab glassware and twice had been accused of not wiping spills of ethidium bromide—a strong mutagen—on lab counters. He was also not terribly cautious about radionucleides. (Reprinted, with permission, from Bear 1986, p. 12.)
>
> Their arrival was viewed as nothing less than an invasion by some workers in Art Riggs's lab. Riggs tended to be meticulous, careful, and considerate; for example, after his technician, Louise Shively, became pregnant, he took over any tasks involving radioactive isotopes. The scientists from San Francisco were different. "It was unbelievable," Shively recalls. "It was clear from the first day that they were random and left a mess piled up behind them wherever they worked. It's like they were whirlwinds." Riggs would occasionally remind them to show some manners at the bench, but as Goeddel admits, "We were so concerned with the project that we weren't really listening too much." To everyone's relief, they did most of their work in a small lab across the hall. (Hall 1987, p. 219.)[1]

Courtesy may not always matter—Vergil died in a novel because of his sloppiness, but Goeddel was actually instrumental in the cloning of the insulin gene—but it certainly helps the lab run more efficiently, smoothly, and pleasantly.

Basic Survival Rules: Attitude

1. **Ask, don't command.** The other people in the lab are coworkers.
2. **Assume nothing.** You should not assume that someone will immediately stop an experiment to help you whenever you need it, that someone else will deal with the alarm on the incubator. Be, at least in the beginning, fairly humble in your expectations. Also, *don't assume that everyone else is always right.*
3. **Write down everything when someone is giving you instructions.** You will be given a lot of information by a variety of people, and you want to avoid asking the same questions over and over. *Record people's names, incubation times and temperatures, locations of reagents, instructions on autoclave use, everything and anything that saves another question.* This has the psychological benefit of not only helping you to remember, but also garnering goodwill points by making it obvious to people that you are interested in what they are saying.

[1]Excerpted from *Invisible Frontiers: The Race to Synthesize a Human Gene* (Atlantic Monthly Press) by Stephen S. Hall (©1987 Stephen S. Hall, reprinted by permission of Melanie Jackson Agency, L.L.C.).

4. **Make appointments or request time with people.** Time is tight when experiments are running—even 5 minutes of someone's time (and, in a lab, almost nothing takes only 5 minutes) might be impossible to get. Ask members when they have the time to show you how to use the balance. Don't wait until your samples are thawing and you have a window of 2 minutes to frantically plead with someone for help.

> *Don't ask questions of busy members who are in the middle of manipulating tubes. Make your presence known and then wait until they are able to respond.*

5. **Don't remove journals from the departmental library,** except to photocopy an article. Replace journals exactly where they belong on the shelves. If eating is permitted in the library, remove all crumbs and debris before you leave. And remember not to leave food in the lab food refrigerator for weeks and weeks.

6. **Don't discuss a fellow lab member's results with people not in the lab.** There may be worries about a competing lab, or the data may not have been repeated enough to make it trustworthy.

> *If a hot result is found in the morning in a lab in New York, everyone in California will know by the afternoon. There are usually far fewer than six degrees of separation between any two lab members, so a sensitive result must be kept completely quiet until the involved researcher is ready to talk.*

Basic Survival Rules: Courtesy at the Bench

1. **Never use reagents or buffers without permission.** The buffers and reagents on people's benches are very precious, and very, very personal. They may be sterile, they may be RNase-free, they may just be private, and you should not even take a milliliter without permission from the owner.

   They may also not be exactly what you think they are or what they are labeled, and their use may end up ruining your experiment. There probably are common lab reagents somewhere—but wait until you are explicitly told what they are, and under which conditions you may use them, before you touch them.

2. **If a common reagent is low or runs out, order more.** *Don't put the empty bottle back.* Find out how to place an order to restock the item. It is a good idea to leave a dated note on the shelf stating that the item has been ordered.

3. **Don't ignore a broken piece of equipment or an equipment alarm.** In your early days, you may not be able to deal with problem equipment, but you should notify other lab members so the appropriate action can be taken. Don't move on to another centrifuge or gel box, leaving the next prospective user to deal with the problem.

Immediate action should be taken if you hear a buzzer or alarm in a piece of equipment, as the consequences of ignoring it can be completely disastrous: In particular, loss of power or temperature maintenance in a low-temperature freezer or liquid nitrogen storage tank can mean the loss of the entire department's clones, cell lines, purified proteins, and cDNA libraries. And if it is your fault that this happens, kiss all goodwill goodbye.

4. **Do not move things around or change the location of any tubes, reagents, or equipment that you encounter in common lab areas.** It isn't the most sensible thing, but people find their reagents as much by location as by label, so put them in a place as close to the original location as possible. If you *must* move something, notify the owner of the material.

5. **Don't leave anything anywhere, except where it belongs or on your lab bench.** This means not a flask in the sink, not a pipette in the garbage, unless it is the correct and designated destination.

6. **If you do something wrong, confess.** Everyone probably knows that you did it, anyway, so tell the truth! It will establish you as an honest member of the community, which is not an insignificant thing in a research profession. Everyone makes mistakes, but sneaking to cover one leaves a nasty taste. Offer to remedy the mistake, if possible.

7. **Clean up immediately after (or better yet, during) each part of an experiment.** *Cleanup is part of the experiment,* not an extra something to do to show you are a nice guy. Be especially careful to keep common areas, such as sinks, cell culture hoods, and electrophoresis areas, free of your paraphernalia and debris. This will help others to expedite their own experiments.

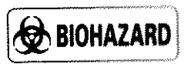
8. **Request the minimum of favors.** It is okay to ask members to stop or finish an experiment for you, if you really must go, and it will take a minimum of activity on their part. Lab workers often depend on each other for this kind of help. But don't present someone with a list of things to finish up because you want to catch a movie.

NONNEGOTIABLE SAFETY RULES

1. **Follow the universal lab safety rules:**

   - *No eating, drinking, or smoking in the lab.* People often grab a bite to eat at their desks, but it is not a good idea; not only is it esthetically and healthwise a bad thing, but the lab safety people will get quite peeved if they catch you. There will be a nearby place to eat and drink.

> *The laboratory may actually be closed down if personnel are found eating in the lab. Usually a warning will be given for the first infraction.*



Be aware of signs that point to potential dangers. Two that are found in many labs are the *yellow radioactive sign*, indicating that radioactive agents are either stored or used there, and the *orange biohazard sign*, which is posted where there may be infectious agents. Don't use anything that post these signs, including refrigerators and incubators, until you have checked with the laboratory safety officer.

- *Don't wear open-toe shoes* or shorts, as they leave you too vulnerable if there is a spill.
- *Wear a lab coat in the lab.* It isn't considered chic in many labs, but it is too easy to lean on a counter, newly washed down with bleach, and leave a lovely hole in your shirt.
- *Don't wear the lab coat out of the lab area.* The lab coat protects you from caustic and infectious substances, and it is foolish to then subject other people to the nasty stuff. If it is de rigeur to wear a lab coat to seminars or to lunch, have a clean one set aside for those occasions.
- *Wear gloves for protection against potentially dangerous materials*—but don't forget that they protect other people as well! Don't use gloved hands to open doors, answer phones, or push elevator buttons, or anything else that can spread the material on the gloves to others.
- *Don't mouth pipette.* Not even sterile water! Ask for a bulb or a mechanical pipetting aid.

If you do this you are crazy

2. **Know how to help yourself and other lab members in case of an emergency.**
   - *Memorize the emergency safety telephone numbers.* There may be one emergency number to be used for any sort of crisis. There may be a number for the institutional EHS, as well as a number for the Campus Police or Security. Don't forget the number of the local police and emergency service.
   - *Find out where the first aid kit, the radiation and chemical spill kits, eyewash and safety showers are.* Be acquainted with the safety rules for your laboratory.
3. **Don't do anything that you think is unsafe.** If you have questions or doubts about any procedure, check with the lab safety officer and the EHS.

Respect yourself
Respect your labmates
→ If you're unsure about safety, delay your work
The delay won't keep us from being awesome, but
injuries or danger will!

RESOURCES

The following books give a flavor for both the professional and personal aspects of biomedical research:

Angier N. 1988. *Natural obsessions. The search for the oncogene.* Houghton Mifflin, Boston, Massachusetts.
Bear G. 1986. *Blood music.* Ace Books, New York.
Crotty S. 2001. *Ahead of the curve: David Baltimore's life in science.* University of California Press, Berkeley.
Goldberg J. 1988. *Anatomy of a scientific discovery.* Bantam Books, New York.
Gornick V. 1990. *Women in science.* Simon and Schuster, New York.
Hall S.S. 1987. *Invisible frontiers. The race to synthesize a human gene.* Tempus Books, Redmond, Washington.
Kornberg A. 1995. *The golden helix. Inside biotech ventures.* University Science Books, Sausalito, California.
Lewis S. 1961. *Arrowsmith.* The New American Library of World Literature, New York.
Maddox B. 2002. *Rosalind Franklin: The dark lady of DNA.* HarperCollinsPublishers, New York.
Teitelman R. 1989. *Gene dreams. Wall Street, academia, and the rise of biotechnology.* Basic Books, New York.
Watson J.D. 1968. *The double helix.* The New American Library, New York.
Weiner, J. 1999. *Time, love, memory: A great biologist and his quest for the origins of behavior.* Alfred Knopf, New York.

If you see other people being unsafe, stop them! Including Koch